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Kidd blood group phenotypes among pregnant women in Sokoto, North Western Nigeria

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ABSTRACT

Objective: To investigate the prevalence of Kidd antigens among pregnant women in Sokoto, North Western Nigeria.

Methods: One hundred and sixty two pregnant women aged 18-45 years [mean age (27.19±4.72) years] attending antenatal clinic in Usmanu Danfodiyo University Teaching Hospital, Sokoto, were screened for the presence of Kidd blood group antigens using the conventional tube method and anti-Jka and Jkb reagents (Lorne Laboratories, UK).

Results: Out of the 162 pregnant women tested, 82 (50.6%) were Hausa, 26 (16%) were Igbo, 23 (14.2%) were Fulani and 20 (12.3%) were Yoruba while the minority ethnic groups were 11 (6.8%). The distribution of Kidd antigen was compared based on the ethnic groups of subjects. Jka antigen was the highest among the Yoruba ethnic group (10.0%) followed by the Hausa ethnic group (7.31%). The prevalence of Jkb was highest among Hausa subjects (10.97%) followed by the Yoruba ethnic group (10.0%). Subjects were categorized based on parity. Majority of the subjects were multigravidae, 122 (75.3%) compared to primigravidae 40 (24.7%). Subjects were stratified based on trimester. A significant number of women were in the second trimester, 111 (68.5%) compared to the third trimester 38 (23.5%) and the first 13 (8.0%). The distribution of Kidd antigens among subjects studied indicated a prevalence of Jka, Jkb and Jk(a+b+) with 8 (4.9%), 13 (8.0%) and 0 (0.0%), respectively. A significant number of subject tested were negative for Kidd antigens. Of the 162 pregnant women tested, 154 (95.1%), 149 (75.3%) and 141 (87.04%) tested were negative for Jka, Jkb, and Jk(a-b-), respectively.

Conclusions: This study indicates that blood group antigens can be distributed differently within different nationalities. Kidd phenotypes observed among pregnant women in this study was similar to previous reports among blacks but at variance with report among Caucasians and Asians. We recommend that detailed routine phenotyping for all clinically significant red cell antigen including Kidd antigen being carried out routinely among all pregnant women in Nigeria. There is also the need to routinely screen all pregnant women for alloantibodies to facilitate the selection of antigen negative units for those with clinically significant alloantibodies who require a red cell transfusion. This can potentially optimise the obstetric management of haemolytic disease of foetus and newborn and prevent haemolytic transfusion reaction among pregnant women.

1. Introduction

In 1951, a patient called Mrs. Kidd was found to have produced antibodies targeted against a then unknown red cell antigen during her pregnancy. The marker was present on the RBCs of her foetus, and the maternal antibodies targeted against it caused fatal haemolytic disease in her newborn child[1]. The protein was given the name Jka and it was the first antigen to be discovered in the Kidd blood group system. Since this time, two other antigens, Jkb and Jk3 have been found. Despite concerted effort by medical laboratory scientists to make transfusion as safe as possible, transfusion practices are still uncertain because transfusion reaction tends to occur after transfusing Kidd blood group antigens positive red blood cells to recipients who are Kidd blood group antigens negative and those who have produced anti-Kidd antibodies from previous sensitizing events (transfusion, abortion and pregnancy). Haemolytic disease of the newborns can also potentially occur in women who are

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negative for Kidd blood group antigens, who are carrying a foetus and who are positive for Kidd blood group antigens. The mother can become sensitized by the foetal RBCs from fetomaternal haemorrhage during pregnancy and delivery of the first unaffected baby, leading to antibody production. These immune antibodies can cross the placenta in subsequent pregnancy involving Kidd positive foetus, resulting in haemolytic disease of foetus and newborn (HDFN)[2,3].

The Jk antigen is found on a protein responsible for urea transport in the RBCs and kidney[4-6]. The gene encoding for this protein is found on the chromosome 18[7]. However, the absence of the Kidd glycoprotein is not associated with disease. The RBCs in Kidd null individuals have a normal shape and lifespan[6]. Individuals with the Jk(a-b-) phenotype are unable to maximally concentrate urine, but it does not cause any other health problems[8].

The Jk antigen is important in transfusion medicine and Kidd antibodies have been incriminated in cases of HDFN[2]. Anti-Jka can cause severe and fatal haemolytic transfusion reactions[9]. The Kidd antibodies are often difficult to detect, making them hazardous in transfusion medicine, where they are suspected to be a common cause of delayed haemolytic transfusion reactions (DHTRs)[9]. Over one-third of DHTRs are caused by anti-Jka[10-13].

There is paucity of data on the prevalence of Kidd blood group antigens among pregnant women in Sokoto, Nigeria. The risk of anti-Kidd related HDFN in this environment is unknown. Therefore the present study is aimed at determining the prevalence of these Kidd antigens among pregnant women in Sokoto, Nigeria. Data generated will help improve the obstetrics care offered to pregnant women in the area and may help justify the need to routinely screen pregnant women in the area for these antigens. Findings from this study will also help blood bank in the area to stock optimum levels of Kidd negative units for pregnant women who are Kidd antigen negative that may require a red cell transfusion as well as those who are positive for anti-Kidd antibodies that require antigen negative red cell for transfusion.

2. Materials and methods

2.1. Study site

The selected area for this study is Usmanu Danfodiyo University Teaching Hospital (UDUTH), which is located in Wamakko Local Government within Sokoto Metropolitan city in Sokoto State. Sokoto State is located in the extreme northwest of Nigeria, near the confluence of the Sokoto River and Rima River. With an annual average temperature of 28.3 °C (82.9 °F). Sokoto is, on the whole, a very hot area. However, maximum day time temperatures for most of the year are generally under 40 °C (104 °F). The warmest months are February to April when daytime temperatures can exceed 45 °C (113.0 °F). The rainy season is from May to October, during which showers are a daily occurrence. There are two major seasons, wet and dry which are distinct and characterized by high and low malarial transmission, respectively. Report from the 2007 National Population Commission indicated that the state had a population of 3.6 million[14].

2.2. Study population

The study population consisted of 162 consecutively-recruited pregnant women aged 18-45 years and mean age (27.19±4.72) years attending antenatal clinic at UDUTH, Sokoto, Nigeria. Verbal informed consent was obtained from each subjects after counselling. Ethical approval was obtained from the ethical committee in UDUTH (UDUTH/HERC/2013/NO.145).

2.3. Study design

This present study is a case study and includes 162 consecutively-recruited pregnant women aged 18-45 years who were investigated for their Kidd blood group antigen status in the blood transfusion laboratory of UDUTH, Sokoto, North Western Nigeria.

2.4. Sampling method and testing procedure

Three millilitres of ethylene diamine tetraacetic acid anticoagulated blood was collected aseptically from each subjects and used for the determination of Kidd phenotype. When testing was delayed, the specimen was stored at 2-8 °C. All blood samples were washed at least 3 times with phosphate buffered saline before being tested. Standard conventional tube method was used for all testing. The manufacturer's standard operating procedure was followed strictly. Kidd phenotype was determined using Lorne Laboratories (UK) anti-Jka and anti-Jkb reagents. Indirect antiglobulin method was used for Jka and Jkb phenotype determination. The principle is based on the ability of anti-Jka and Jkb antibody reagents to cause agglutination (clumping) of test RBCs, which carry the Jka and Jkb antigen, in the antiglobulin phase of testing. No agglutination generally indicate the absence of the Jka and Jkb antigens. In summary, the test RBCs were washed three times in phosphate buffer saline solution, a 3% suspension of washed RBCs was made, equal volume (1 volume) of 3% washed RBCs and anti-Jka or Jkb [Lorne Laboratories (UK)] were placed in a labelled test tube, the mixture was mixed thoroughly and incubated at 37 °C for 15 min, it was then washed three more times with phosphate buffered saline and supernatant was decanted, two volumes of antihemophilic globulin was added then mixed and centrifuged for 20 seconds at 1 000 r/min and the sediment was re-suspended and

observed macroscopically and microscopically for agglutination.

2.5. Inclusion criteria

All pregnant women who meet the following eligibility criteria: aged 18–45 years, confirmed pregnant by a qualified gynaecologist, attending antenatal clinic in UDUTH, resident in Sokoto metropolis and willingness to offer informed consenting after counselling were recruited into the study.

2.6. Exclusion criteria

The following women who did not meet the eligibility criteria: non-pregnant women, non-consenting pregnant women, pregnant women who have had a recent red cell transfusion in the last 3 months were excluded from the study.

2.7. Statistical analysis

The data collected was recorded on an Excel spreadsheet and later subjected to statistical analysis using a statistical software SPSS Version 18.0 (Chicago, Illinois). Statistical analysis included descriptive statistics of mean and bivariate analysis of *t*-test and *Chi*-square. Correlation was compared using linear regression analysis. Differences were considered significant when $P \leqslant 0.05$.

3. Results

One hundred and sixty two pregnant women aged 18–45 years [mean age (27.19±4.72) years] attending antenatal clinic in UDUTH, Sokoto were screened for the presence of Kidd blood group antigens. Out of the 162 pregnant women tested, 82 (50.6%) were Hausa, 26 (16%) were Igbo, 23 (14.2%) were Fulani and 20 (12.3%) were Yoruba while the minority ethnic groups were 11 (6.8%).

The distribution of Kidd antigen was compared based on the ethnic groups of subjects. The prevalence of Jka antigen was highest among the Yoruba ethnic group (10.00%) followed by the Hausa ethnic group (7.31%). The prevalence of Jkb was highest among Hausa subjects (10.97%) followed by the Yoruba ethnic group (10.00%). The distribution of Kidd antigens based on ethnicity is shown in Table 1.

Table 1

Distribution of Kidd antigen based on ethnicity.

Ethnic group	Number tested	Jka positive	% Jka positive	Jkb positive	% Jkb positive
Hausa	82	6	7.31	9	10.97
Fulani	23	0	0.00	1	4.34
Yoruba	20	2	10.00	2	10.00
Igbo	26	0	0.00	1	3.85
Others	11	0	0.00	0	0.00

Subjects were categorized based on parity. Majority of the subjects were multigravidae 122 (75.3%) compared to primigravidae 40 (24.7%).

Subjects were stratified based on trimester. A significant number of women were in the second trimester 111 (68.5%) compared to the third trimester 38 (23.5%) and the first 13 (8.0%).

The distribution of Kidd antigens among subjects studied indicated a prevalence of Jka, Jkb and Jk(a+b+) 4.9% (8), 8.0% (13) and 0% (0) respectively.

A significant number of subject tested were negative for Kidd antigens. Of the 162 pregnant women tested, 154 (95.1%), 149 (75.3%) and 141 (87.04%) tested were negative for Jka, Jkb, and Jk(a–b–), respectively.

4. Discussion

Kidd blood group system are clinically significant because of the the ability of antibodies of the blood group systems to cause HDFN and transfusion reaction. In this present study, we investigated the prevalence of Kidd antigens among pregnant women in Sokoto, North Western Nigeria.

In this study, we observed a prevalence of 4.9% and 8.0% for Jka and Jkb phenotype, respectively. The prevalence of our finding was lower than that of the report from a previous study which investigated the frequencies of Kidd antigens among four indigenous Chinese ethnic populations: Han, Tajik, She, and Yugu. The frequencies of Jka and Jkb alleles were 0.49 and 0.51 among Hans and 0.56 and 0.44 among Shes, respectively[15]. Our finding is however at variance with a previous report which investigated the prevalence of Jka and Jkb phenotype among Caucasians, Chinese and blacks and observed a prevalence of 77.0%, 73.0% and 92.0%, and 74.0%, 76.0% and 49.0% respectively[16]. Anti-Jka can cause severe and fatal haemolytic transfusion reactions but is more commonly associated with less severe DHTRs[9]. Previous report indicated that over one-third of DHTRs were caused by anti-Jka[11]. Case studies have also pointed out that anti-Jkb were responsible for severe DHTR[17]. During pregnancy, foetal Kidd antigens are capable of crossing the placenta barrier and causing alloimmunization of the mother[2]. But in contrast to the haemolytic activity of Kidd antibodies in incompatible blood transfusions, anti-Jka and anti-Jkb are only rarely responsible for severe HDFN[18]. The alloantibodies, which frequently being developed and encountered during compatibility testing, are primarily against antigens related to Kidd antigens[19,20]. Kidd blood group system are clinically significant[21] and have been incriminated in cases of haemolytic transfusion reactions[11,22] and HDFN[23,24].

Blood group antigens can be distributed differently within different nationalities. In this present study, we did not detect any Jk(a+b+) phenotype among our cohort of pregnant women. However, a previous report to determine the presence of clinically significant blood group antigens

in the Lao population indicated a Jk(a+b+) prevalence of 39.44%[25]. Similarly, a study that investigated a total of 115 O blood group donors from three different blood banks of South Gujarat who were typed for Kidd antigens obtained a prevalennce of 52.17% for Jk(a+b+)[26]. Also, a previous report among randomly selected 123 regular Maldivian blood donors of O group who were phenotyped for Kidd antigen in Malaysia observed that the incidence of Jk(a+b+) phenotype was the most common in the Kidd blood group system[27]. Similar findings have been reported in Asian and Thai populations[28].

In our study, we observed Jk(a-b-) phenotype commonly known as antigen Jk3 in 87.04% of our subjects. Jk(a-b-) has rarely been found. A previous study showed low prevalence of Jk(a-b-) among Malays (3.5%) and Indians (1.7%)[28]. Similarly, the Jk(a-b-) was only rarely found in Polynesians[16] and Japanese[29]. Previous report suggested that the absence of the Kidd glycoprotein is not associated with disease and that the RBCs in Kidd null individuals have a normal shape and lifespan[6]. Similarly, a previous report indicated that individuals with the Jk(a-b-) phenotype were unable to maximally concentrate urine, but it does not cause any other health problems[8]. Kidd blood group system is one of the clinically significant blood group system. During pregnancy, foetal Kidd antigens are capable of causing alloimmunization of the mother[30-33]. However, incompatible blood transfusions involving anti-Jka and anti-Jkb are only rarely responsible for severe HDFN[18].

This study indicates that blood group antigens can be distributed differently within different nationalities. Kidd phenotypes observed among pregnant women in this study is similar to the previous reports among blacks but at variance with the reports among Caucasians and Asians.

The sample size for this study was relatively small compared to the huge population of women in Nigeria. It, however, gives a picture of the prevalence of Kidd antigen among pregnant women in Sokoto, North Western Nigeria. And there is the need to carry out a large randomized countrywide study to determine the prevalence of Kidd antigens among Nigerians. Cost implications as well as access to reagents was a limiting factor that affected the number of subjects included in this study. Secondly, we used the conventional manual tube method for the determination of the Kidd antigen status of our subjects. Other previous reports used the more sensitive method with commercial antisera and gel card. The gel and glass beads-based card method has several advantages over the conventional tube method. The advantages include paediatric friendly because they require small volume of patient specimen, unlike the tube methods; no washing of the antiglobulin is required, it is more standardized and does not require the subjective red cell suspension preparation required with the conventional tube method; the results are more objective (clear, eye and analyser readable) and does not require use of microscopes as required in tube testing; and it is easy to automate, unlike conventional tube method and thus very useful for high throughput laboratories. It also facilitates large batch testing with no risk of possible mix-up of patient samples compared with tube testing and it is more sensitive and specific and has the capacity to detect individuals with very weak reactions compared to the conventional tube method.

Knowledge of the distribution of red cell antigens can help to prevent alloimmunisation and haemolytic transfusion reaction among pregnant women and multi-transfused patients by facilitating the provision of antigen negative blood for pregnant women and transfusion-dependent patients with alloantibodies. It can also facilitate the optimum stocking of blood banks in the area based of the relative prevalence of the Kidd and the various clinically significant red cell antigens in the population. We recommend that detailed phenotyping for all clinically significant red cell antigen including Kidd antigen being carried out routinely among all pregnant women in Nigeria. There is also a need to routinely screen all pregnant women for alloantibodies at antenatal booking to identify women at risk for HDFN as well as facilitate the selection of antigen negative units for those with clinically significant alloantibodies who may require a red cell transfusion during pregnancy or delivery. This will facilitate the optimum obstetric management of HDFN in pregnant women who have a clinically significant alloantibody.

Conflict of interest statement

We declare that we have no conflict of interest.

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